



**State of Louisiana  
Department of Natural Resources  
Coastal Restoration Division**

**Monitoring Plan**

for

**Jonathan Davis Wetland Restoration**

State Project Number BA-20  
Priority Project List 2

August 2003  
Jefferson Parish

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## MONITORING PLAN

### PROJECT NO. BA-20 JONATHAN DAVIS WETLAND RESTORATION

**ORIGINAL DATE: July 10, 1995**

**REVISED DATES: July 23, 1998; August 14, 2003**

#### Preface

Pursuant to a CWPPRA Task Force decision on April 14, 1998, the original plan was reduced in scope due to budgetary constraints. Specifically, water level and salinity will be monitored continuously through 2005. Upon collection and evaluation of this data set, the Technical Advisory Group (TAG) will assist in development of a sampling plan based on an approximate 30% reduction of effort, if technically advisable.

Pursuant to a CWPPRA Task Force decision on August 14, 2003 to adopt the Coastwide Reference Monitoring System (CRMS-*Wetlands*) for CWPPRA, updates were made to this Monitoring Plan to merge it with CRMS to provide more useful information for modeling efforts and future project planning while maintaining the monitoring mandates of the Breaux Act. The implementation plan included review of monitoring efforts on currently constructed projects for opportunities to 1) determine if current monitoring stations could be replaced by CRMS stations, 2) determine if monitoring could be reduced to evaluate only the primary objectives of each project and 3) determine whether monitoring should be reduced or stopped because project success had been demonstrated or unresolved issues compromised our ability to actually evaluate project effectiveness. The recommendations for modifying this Monitoring Plan are the result of a joint meeting with DNR, USGS, and the federal sponsor.

Because the project was not completely constructed as originally designed, the monitoring plan was streamlined to more efficiently capture project effects. Specifically, CRMS 289 will replace stations BA20-11 and BA20-91R, Davis Pond station 10 will replace station BA20-90R, and CRMS262 will replace station BS20-08. The sonde at station BA20-20 will remain. In addition, soil sampling was dropped, and habitat mapping originally scheduled for 2014 will be replaced by land:water analysis. Habitat and vegetation change data will be supplemented with Chabreck and Linscombe data. Finally, Shoreline monitoring will remain as originally planned; however, discrete hydrography will be discontinued at the end of 2004. These recommendations have been incorporated into this revised Monitoring Plan and are described in the Monitoring Elements section.

#### Project Description

The proposed project area totals 7,199 ac (2,880 ha) of wetlands classified as intermediate marsh located in Jefferson Parish within the Barataria Basin (U.S. Soil Conservation Service 1994). The project area is bounded on the north by the Paillet Canal, on the east by La. Hwy. 301, on the south by Bayous Perot and Rigolettes, and on the west by the Gulf Intracoastal Waterway (GIWW) (figure 1).



**Figure 1.** Jonathan Davis Wetland Restoration Project (BA-20), location of project area, reference area and monitoring stations.

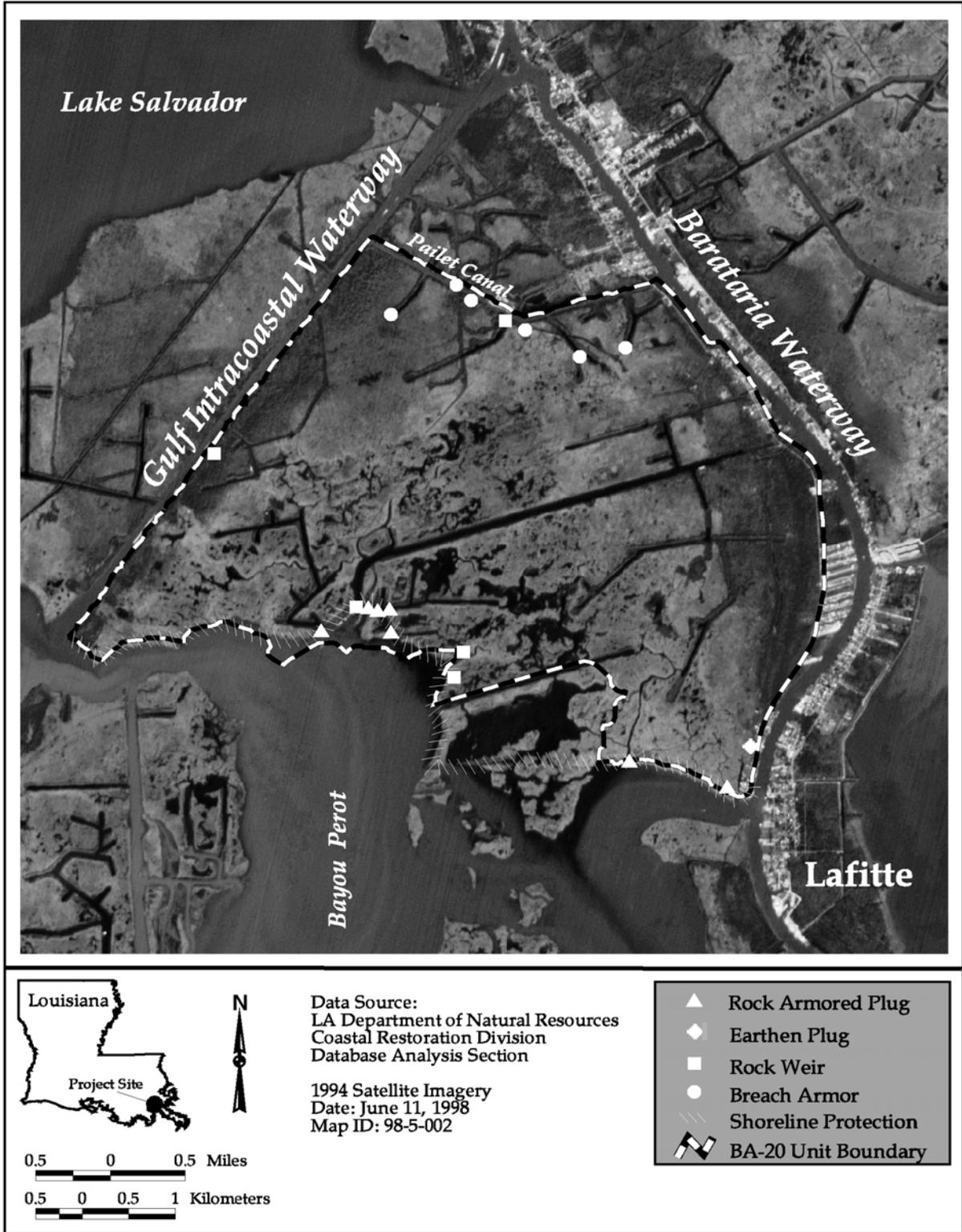
Vegetation in the project area is dominated by *Spartina patens* (marshhay cordgrass) and *Sagittaria lancifolia* (bulltongue). Other common species include *Scirpus americanus* (olney threesquare), *Typha* sp.(cattail), *Eleocharis* sp. (spikerush), *Juncus effusus* (soft rush), *Baccharis halimifolia* (eastern baccharis), *Panicum repens* (torpedograss), *Ipomoea sagittata* (morning-glory), *Bacopa monnieri* (waterhyssop), *Alternanthera philoxeroides* (alligatorweed), and *Hydrocotyle* sp. (pennywort) (U.S. Soil Conservation Service 1994).

The project area consists mainly of the Lafitte-Clovelly soil type with some areas of Harahan clay and Barbary muck (U.S. Soil Conservation Service 1983) (figure 2). The Lafitte-Clovelly association is characterized as level, very poorly drained, saline, semifluid organic and highly erodible soils. Harahan clay soils are level, poorly drained mineral soils in low positions on the natural levees of the Mississippi River and its distributaries. Barbary muck is a level, very poorly drained semifluid mineral soil.

Overall, 1,393 ac (557 ha) of land have been converted to open water between 1945 and 1989 (Coastal Environments Inc. 1991). The average rate of change of marsh to non-marsh (including loss to both open water and commercial development) has been increasing since the 1940s. Marsh loss rates were 0.56%/yr between 1939 and 1956. Between 1956 and 1974 loss rates were 0.69%/yr; and between 1983 and 1990 loss rates were 0.73%/yr (Dunbar et al. 1992).

It is the opinion of the National Resources Conservation Service (NRCS; formerly the Soil Conservation Service, SCS), as reported in the Marsh Plan and Environmental Assessment (1994), that major factors influencing wetland loss within the project area are increased water exchange, saltwater intrusion, tidal scour, and shoreline erosion along Bayous Perot and Rigolettes. Shoreline erosion from 1945 to 1989 caused primarily by wave action along Bayou Perot has been measured at 20 ft/yr (6.1 m/yr)(Coastal Environments Inc. 1991). Water exchange and tidal scour are believed to have been enhanced with the construction of various oil field canals. Numerous oil field canals were dredged in the 1940s when oil companies were not responsible for maintaining a continuous spoil bank along the canals. As a result, the breaches that occurred were not repaired and subsequently exposed the interior marsh to increased tidal flows and salinity during storm surges (U.S. Soil Conservation Service 1993). National Biological Survey (NBS) Geographic Information System (GIS) data from 1956 characterized the majority of the area as fresh marsh. However, the 1978 and 1990 data indicate that the area has become more saline. In both 1978 and 1990, the area was classified as primarily intermediate marsh (NBS 1978, 1990). Chabreck and Linscombe (1988) also characterize the area as intermediate marsh. Other large scale factors influencing degradation in the Barataria basin include subsidence, lack of sedimentation, and reduced freshwater influx due to the levee system on the Mississippi River and its major distributaries.

Subsidence rates based on U.S. Army Corps of Engineers (USACE) tide gage readings (1947–78) at Bayou Rigaud, Grand Isle, La., is 0.80 cm/yr (Penland et al. 1989). To compound this problem, there are no major external sources of inorganic sediment into the project area although some sediments do enter via the GIWW. Moreover, the increased tidal exchange during storm surges caused by the many oil field canals within the area has facilitated the export of a large portion of the indigenous inorganic and organic sediments (U.S. Soil Conservation Service 1994).



**Figure 2.** Jonathan Davis Wetland Restoration Project (BA-20), location of project area and features.

This project is a hydrologic restoration and seeks to reduce marsh loss and restore historical hydrologic conditions that reduce rapid water level and salinity fluctuations and are conducive to the retention of available fresh water. Measures included for this purpose are as follows (figure 2):

- approximately 1,040 ft (317 m) of low sill rock weirs (5 structures)
- approximately 70 ft (21 m) of earthen plug (1 structure)
- approximately 1,560 ft (475 m) of rock-armored earthen plugs (7 structures)
- approximately 780 ft (238 m) of breach armoring (6 locations)
- approximately 34,000 ft (10.4 km) of shoreline stabilization along the entire southern boundary of the project area

### Project Objectives

1. Use structural measures to restore hydrologic conditions that reduce water level and salinity fluctuations (variability) and allow greater freshwater retention to increase quantity and quality of emergent vegetation.
2. Reduce wetland loss through hydrologic restoration and shoreline protection to reduce erosion.

### Specific Goals

The following goals will contribute to the evaluation of the above objectives:

1. Reduce existing rate of loss of emergent marsh.
2. Decrease variability in salinity within the project area.
3. Decrease variability in water level within the project area.
4. Reduce marsh edge erosion rate along southern project boundary.
5. Stabilize or increase relative abundance of intermediate-to-fresh marsh type plant species.

### Reference Area

The importance of using appropriate reference areas cannot be overemphasized. Monitoring on both project and reference areas provides a means to achieve statistically valid comparisons, and is therefore the most effective means of assessing project success. Various locations in the vicinity of the project area were evaluated for their potential use as a reference area. The evaluation of sites

was based on the criteria that both project and reference areas have similar vegetative community, soil, hydrology, and salinity characteristics. There were several locations chosen for use as a reference area specific to individual monitoring elements. Two areas directly to the southeast and southwest of the project along Bayou Rigolettes and Perot respectively, were feasible. In addition, the area directly north of the project above the Paillet Canal and the area above GIWW to the northwest were also suitable locations (figure 1). These sites were chosen because they satisfied the above mentioned criteria for choosing a suitable reference area. Both the project area and the proposed reference sites are classified as intermediate marsh (Chabreck and Linscombe 1988) and both contain mainly the Lafitte-Clovelly soil type (U.S. Soil Conservation Service 1983). Preliminary salinity monitoring indicates similar salinities in both project and reference sites. Both reference areas south of the project and the project area proper have shorelines along Bayou Rigolettes and Perot, major traversed bayous where extensive shoreline erosion is occurring.

Prior to the implementation of CRMS, the reference site to the southeast of the project area was used in the evaluation of all monitoring elements. The reference sites to the north and southwest of the project area in Bayou Perot were used in the evaluation of salinity and water level monitoring elements. The site to the northwest above GIWW was used as a reference site for the vegetation and habitat mapping components of monitoring. As the chosen reference sites (approximately 1900 ac [769 ha]) are smaller than the project area (approximately 7200 ac [2,914 ha]), a reduced number of sampling stations were used for monitoring vegetation, soil samples, and shoreline erosion. The specific numbers are listed in the monitoring elements section of this plan. Aerial photography for the habitat mapping monitoring element will be flown for both the project area and the reference sites.

Some aspects of the hydrology of the reference sites to the southeast and northwest are unknown. Both the project and reference areas contain open connections to large water bodies and have natural and anthropogenic bayous running throughout, however, specific hydrologies are currently being investigated. Baseline monitoring will yield more information concerning flow patterns, water levels, and frequency and duration of flooding. The sites will at that time be re-evaluated for use as a suitable reference area.

After the implementation of CRMS, project/reference pairs of sondes will remain to evaluate project effects on hydrology, however, vegetation changes will be compared to other CRMS sites within Barataria Basin within the same habitat type. In addition, CRMS will provide sediment elevation through Sediment Erosion Tables (SETs) and accretion through Feldspar measurements. These project data will be comparable to other data collected at CRMS sites throughout Barataria Basin and also throughout the coast.

CRMS will provide a pool of reference sites within the same basin and across the coast to evaluate project effects. At a minimum, every project will benefit from basin-level satellite imagery and land:water analysis every 3 years, and supplemental vegetation data collected through the periodic Chabreck and Linscombe surveys. Other CRMS parameters which may serve as reference include Surface Elevation Table (SET) data, accretion (measured with feldspar), hourly water level and salinity, and vegetation sampling. A number of CRMS stations are available for each habitat type

within each hydrologic basin to supplement project-specific reference area limitations.

### Monitoring Elements

The following monitoring elements will provide the information necessary to evaluate the specific goals listed above:

1.     Habitat Mapping     To document marsh to open-water ratios and marsh loss rates as well as changes in vegetative community type, color-infrared aerial photography (1:12,000 scale, with ground control markers) will be obtained by NBS for both project and reference areas. The photography will be georectified, photointerpreted, mapped, ground truthed, and analyzed with GIS by National Wetlands Research Center (NWRC) following procedures outlined in Steyer et al. 1995. Photography was obtained twice prior to construction in 1994 and 1997, and once after construction in 2002. An additional photography will be taken in 2014. Based on the CRMS review, habitat analysis will be performed on the photography from 1994, 1997, and 2002, however, only land:water analysis will be performed on photography from 2014.

2.     Salinity             Salinity will be sampled monthly at three continuous recorders located within the project area and three located at reference sites (figure 1). Discrete salinity will be measured monthly at 17 stations in the project area with a salinometer. Both a surface and a bottom reading will be obtained at each station. Discrete data will be used to characterize the spatial variation in salinity throughout the project area and will be used in concert with the continuous recorders to statistically model the system. Monthly discrete sampling will not require any appreciable increase in monitoring time as we will concurrently be servicing the continuous recorders. Salinity was collected 1995-1999 (pre-construction) and will be monitored 2000-2004 (post-construction).

Based on the CRMS review, hydrography data were analyzed and were found to be equivalent at various stations. Consequently, stations 11 and 91R will be replaced by CRMS289, station 8 will be replaced by CRMS262, and station 90R will be replaced by Davis Pond station 10 (BA01-10).

3.     Water Level         Water level will be sampled monthly at three continuous recorders located in the project area and three located at reference sites (figure 1). A staff gauge will be surveyed adjacent to the continuous

recorders so as to tie recorder water levels to a known datum. Staff gages and continuous recorders will be surveyed to the North American Vertical Datum (NAVD). Marsh elevation will be surveyed at each site and used to determine annual duration and frequency of flooding. Water level was collected 1995-1999 (pre-construction) and will be collected 2000-2004 (post-construction).

Based on the CRMS review, hydrography data were analyzed and were found to be equivalent at various stations. Consequently, stations 11 and 91R will be replaced by CRMS289, station 8 will be replaced by CRMS262, and station 90R will be replaced by Davis Pond station 10 (BA01-10).

4. Shoreline Change

To evaluate marsh edge movement, GPS will be used to document marsh edge position. Several discrete stations will be established within the project area along the 34,000 ft (10.4 km) of the rock riprap shoreline protection structure. Points will be established on the actual structure as well as on the marsh edge adjacent to and behind the structure at maximum intervals of 50 ft (15.2 m) (680 points). Stations will also be established at 50 feet intervals along the marsh edge located on the reference area to the southeast of the project area (220 points). In addition, historical rates (as ft/yr loss) of erosion will be obtained (Coastal Environments Inc. 1991) and compared to erosion rates after project implementation. GPS measurements were taken in 1999 (as-built) and 2002 and will be taken again in 2005, 2008, 2011, and 2014 post-construction.

5. Vegetation

Species composition and relative abundance will be evaluated in the project and reference areas using techniques described in Steyer et al (1995). More specifically, the Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974) will be utilized, and stations will be established along transects in the project and reference areas. Four 2.5 mi (4 km) and one 1.5 mi (2.4 km) transect will be run parallel to the GIWW within the project area. Plot sizes will be 2m x 2m (4m<sup>2</sup>) and will be sampled at 0.5 mile increments along each transect for a total of 28 sampling plots within the project area. Three 0.5 mi (0.8 km) and one 1.5 mi (2.4 km) transect will be run in two of the reference areas and will yield 10 sampling plots (figure 1). Transects were surveyed in 1996 and 1999 (preconstruction) and in 2002 (post-construction).

Based on the CRMS review, vegetation surveys originally planned for 2005, 2008, 2011, and 2014 were eliminated and replaced with vegetation data to be collected at CRMS289 and CRMS262.

## Anticipated Statistical Tests and Hypotheses

The following hypotheses correspond with the monitoring elements and will be used to evaluate the accomplishment of the project goals.

1. Descriptive and summary statistics on historical data (1956, 1978, 1988) and data from aerial photography and GIS interpretation collected during post-project implementation will be used to evaluate marsh to open water ratios and marsh loss rates. If sufficient historical information is available, regression analyses will be done to examine changes in slope between pre- and post-conditions. In addition, the shoreline of the project area will be compared to that of the southeastern reference area.

*Goal:* Reduce existing rate of loss of emergent marsh.

2. The primary method of analysis will be to determine differences in mean salinity variability as evaluated by an analysis of variance (ANOVA) that will consider *both* spatial and temporal variation and interaction. The ANOVA approach may include terms in the model to adjust for station locations, proximity to structures, and seasonal fluctuations. Historic data available from Louisiana Department of Health and Hospitals (LDHH) and USACE (as well as from any other available sources) will be used to augment those data collected by DNR/CRD for use as pre-construction data. Ancillary data (i.e., precipitation, historical) will be included as covariables when available. This additional information may be evaluated through analysis such as correlation, trend, multiple comparisons, and interval estimation. Exploratory data analysis will be used to determine an appropriate variable for hypothesis testing (e.g. daily, weekly intervals).

*Goal:* Decrease variability in salinity within the project area.

*Hypothesis A:*

$H_0$ : Salinity variability within the project area will not be significantly less than the salinity variability within the reference area.

$H_a$ : Salinity variability within the project area will be significantly less than the salinity variability within the reference area.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

*Hypothesis B:*

$H_0$ : After project implementation at year  $i$ , salinity variability will not be significantly less than before project implementation.

H<sub>a</sub>: After project implementation at year *i*, salinity variability will be significantly less than before project implementation.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

3. The primary method of analysis will be to determine differences in mean water level variability as evaluated by an ANOVA that will consider *both* spatial and temporal variation and interaction. The ANOVA approach may include terms in the model to adjust for station locations, proximity to structures, and seasonal fluctuations. Ancillary data (i.e., precipitation, historical) will be included as covariables when available. This additional information may be evaluated through analysis such as correlation, trend, multiple comparisons, and interval estimation. Descriptive and summary statistics will be used to aid in the determination of differences in water level variability and for calculating frequency and inundation of marsh flooding. Exploratory data analysis will be used to determine an appropriate variable for hypothesis testing (e.g., daily, weekly intervals).

*Goal:* Decrease variability in water level within the project area.

*Hypothesis A:*

H<sub>0</sub>: Water level variability within the project area will not be significantly less than the water level variability within the reference area.

H<sub>a</sub>: Water level variability within the project area will be significantly less than the water level variability within the reference area.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

*Hypothesis B:*

H<sub>0</sub>: After project implementation at year *i*, water level variability will not be significantly less than before project implementation.

H<sub>a</sub>: After project implementation at year *i*, water level variability will be significantly less than before project implementation.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

4. The primary method of analysis will be to determine differences in shoreline erosion as evaluated by an ANOVA that will consider *both* spatial and temporal variation and interaction. The ANOVA approach may include terms in the model to adjust for station

locations, proximity to structures, and seasonal fluctuations. Historic data is available from CEI (1991) on shoreline erosion from the project area (currently 7-20 ft/yr). Ancillary data (i.e., precipitation, tidal, historical) will be included as covariables when available. This additional information may be evaluated through analysis such as correlation, trend, multiple comparisons, and interval estimation.

*Goal:* Reduce marsh edge erosion rate along southern project boundary.

*Hypothesis A:*

$H_0$ : Shoreline erosion rate within the project area will not be significantly less than the shoreline erosion rate within the reference area.

$H_a$ : Shoreline erosion rate within the project area will be significantly less than the shoreline erosion rate within the reference area.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

*Hypothesis B:*

$H_0$ : After project implementation at year  $i$ , shoreline erosion rate will not be significantly less than before project implementation.

$H_a$ : After project implementation at year  $i$ , shoreline erosion rate will be significantly less than before project implementation.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

5. The primary method of analysis will be to determine differences in relative abundance of vegetation as evaluated by an ANOVA that will consider *both* spatial and temporal variation and interaction. The ANOVA approach may include terms in the model to adjust for station/transect locations, proximity to structures, and seasonal fluctuations. Ancillary data (i.e., herbivory, historical) will be included as covariables when available. This additional information may be evaluated through analysis such as correlation, trend, multiple comparisons, and interval estimation.

*Goal:* Stabilize or increase relative abundance of intermediate-to-fresh marsh type plant species.

*Hypothesis A:*

$H_0$ : Mean relative abundance of vegetation within the project area at time  $i$  will be significantly less than the mean relative abundance of vegetation within



4. The twenty year monitoring plan development and implementation budget for this project is \$816,885. Pursuant to the CRMS review, it was authorized by the Task Force to maintain \$663,613 with the project, and utilize \$153,272 to support CRMS. Progress reports will be available in 2000. Comprehensive reports on coastal restoration efforts in the Barataria hydrologic basin will be available in 2005, 2008, 2011, 2014, and 2017. These reports will describe the status and effectiveness of the project as well as cumulative effects of restoration projects in the basin.
5. Water levels and existing marsh levels will be evaluated and used to calculate duration and frequency of flooding (MSL marsh level elevation and NGVD will be established).
6. The project area was last flown for color-infrared aerial photography (1:12,000) in November 1997 for DNR/CRD.
7. Available ecological data, both descriptive and quantitative, will be evaluated in concert with all of the above data and with statistical analysis to aid in determination of the overall project success.
8. The possibility exists for additional aerial photography being flown to augment that required for the habitat mapping monitoring element. This intermittent photography will aid in the evaluation of marsh to open water ratios.
9. Any additional sources of data (i.e., LDWF, Corps of Engineers, LDHH, etc.) will be used to better develop monitoring protocol and in evaluation of project effectiveness.
10. If DNR/CRD monitoring data, as evaluated by a statistician, reveal that an inadequate number of stations are being monitored (e.g. too few stations to detect variability in monitoring variables) the TAG will be consulted so as to rectify the problem.
11. DNR/CRD is currently monitoring the project and reference areas in order to acquire preconstruction data. Monitoring was initiated in December 1994.
12. The possibility exists that the locations of the continuous recorders may be used interchangeably with those required in the monitoring of the Davis Pond Freshwater Diversion.
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